openreach

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Suppliers' Information Note

For The Openreach Network

Generic Ethernet Access Multicast

Service & Interface Description

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1. Introduction

The Openreach Next Generation Access (NGA) portfolio provides high bit rate access solutions utilising fibre and existing copper based infrastructure as described in SIN506 [7] and SIN498 [6].

This document describes the enhancement to these products to support a Multicast service capability. Specifically, this document provides details relevant to CPs regarding multicast protocols, operation and features.

This Suppliers' Information Note (SIN) provides details relevant to CPs regarding connectivity and interfaces.

It should be noted that the information contained within this SIN might be subject to change due to either the results of Openreach developments, testing or due to feedback from customers. Please check with the https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do site to ensure you have the latest version of this document.

Users of this document should not rely solely on the information contained in it, but should carry out their own tests to satisfy themselves that terminal equipment will work with the Openreach network

Further information regarding the multicast product can be obtained by contacting your Openreach Sales & Relationship Manager.

2. Service Outline

2.1 General

Openreach provides the Multicast product, a Next Generation Access (NGA) product, at GEA-FTTP, GEA-FTTC and GEA-G.fast locations.

2.2 Service Availability

Openreach provides Generic Ethernet Access on Fibre to the Cabinet (GEA-FTTC),Fibre to the Premises (GEA-FTTP) and G.fast infrastructure. Multicast is available at all deployed and released Layer 2 Switches (L2S).

3. Interface Descriptions

3.1 GEA-Cablelink

Unless otherwise stated, the existing FTTx NGA SINs apply and are not repeated herein.

Multicast is supported by a dedicated Multicast VLAN over one, and only one, GEA-Cablelink interface per CP per L2S. This Multicast VLAN provides isolation between different CPs and their users in all aspects of multicast operation including layer 2 and layer 3.

The Ethertype of the GEA-Cablelink as a whole is configurable as described in existing FTTx SINs. The outer VLAN Ethertype configured shall also apply to the Multicast VLAN.

The Multicast VLAN shall carry the media streams (multicast channels) downstream from the CP and IGMP messaging to and from the NGA network.

3.1.1 Multicast VLAN tagging

The Multicast VLAN is single tagged (IEEE 802.1Q).

The Multicast VLAN will have a VLAN ID in the range 3001 to 3070.

The CP cannot specify the multicast VLAN ID to be added; Openreach will allocate the lowest available unused tag ID on a per L2S basis. This will be in the range 3001-3070. CPs may be allocated a different multicast VLAN ID across L2Ss within the same exchange.

Note - It is not possible for CPs to change the VLAN tag ID once the Multicast VLAN has been ordered.

CPs should note that multicast traffic on egress from the Modem/ONT UNI port will be untagged.

3.1.2 Multicast VLAN bandwidths

Multicast VLANs will be available at discrete bandwidths. These will be available in the range of 0Mbit/s to 860Mbit/s, between 0Mbit/s and 200Mbit/s, there is an increment of 5Mbit/s, between 200Mbit/s and 500Mbit/s, and there is an increment of 10Mbit/s. Beyond 500Mbit/s the increments are of 20Mbit/s. The bandwidth will be policed on ingress at the L2S.

NB - 1Mbit/s = 1,000,000 bits/s

3.1.3 Ethernet OAM

Ethernet OAM is not supported on multicast VLAN.

3.1.4 Bridging Loops

To prevent MAC table corruption and bridging loops, CPs should avoid reflecting L2 frames back into the Openreach network.

3.1.5 Downstream priority marking

All Multicast traffic will be given higher priority than all Data traffic from the GEA Cablelink to the ONT / DSLAM. It will, however, be given a lower priority than FVA traffic.

CPs are advised to set the VLAN priority of the Multicast traffic (media and IGMP) to 802.1p level 3.

Openreach will remark downstream Multicast traffic to level 3 on ingress to the L2S.

The priority range of GEA data C-VLAN is 0-4. This gives the CP control of the Data traffic priority such that selected delay sensitive applications can be promoted above Multicast. This prioritisation applies only at the downstream egress queue at DSLAM line card and within ONT; Multicast is always prioritised above data through the OLT/L2S.

3.1.6 GEA Data Downstream shaping

In order to maintain the best possible jitter performance to both Multicast and GEA Data streams, CPs are urged to shape media streams on a per channel basis as opposed to simply shaping the aggregate of the channel streams.

Openreach will not provide any form of messaging to the CP with regard to bandwidth consumed by Multicast for GEA. CPs are encouraged to consider their own solution to ensure they can manage both the Multicast and Data services according to the available downstream rate.

3.1.6.1 GEA-FTTC and GEA-G.fast

The combined Multicast and Data downstream bandwidth available to FTTC and G.fast served users is constrained by the capabilities of the physical access line.

End Users consuming Multicast for GEA will incur reduced bandwidth available to GEA Data owing to the higher priority of Multicast traffic.

3.1.6.2 GEA-FTTP

The combined Multicast and Data downstream bandwidth available to FTTP served users is expected to be controlled by CPs to be within the peak downstream bandwidth ordered for the GEA Data service. Openreach will not at this stage enforce this, but reserves the right to do so in future.

Until Openreach enforces the sum of Multicast and Data traffic remaining within the peak downstream bandwidth ordered, the CP will be responsible for ensuring that sum of the traffic can be handled correctly by their CPE.

3.1.7 IGMP Operation - CP side

Openreach will control the excessive unauthorised rate of flow of Ethernet multicast frames by utilising IGMP messages from CPE equipment and report these to the CP interface via a proxy agent. Therefore when multiple users request to join a particular group the CP will see only the first IGMP join to that group and the last IGMP leave from that group. The CP will have no visibility of the original user's IGMP message either via the Multicast VLAN or Data VLAN.

IGMP Membership Queries from the CP to the GEA network must avoid using an IP header source address in the same range as that used for GEA element management. Specifically address range 10.0.0.0/8 should be avoided. Note that additional management reserved ranges are likely to be needed by Openreach in future. It is recommended CPs avoid using addresses in this range to ensure their Query messages are not ignored.

The Openreach GEA network will support IGMPv3 as defined by RFC3376 except for known limitations, as described in section 3.3.2. Note that IGMPv3 includes backward compatibility to IGMPv2. IGMPv1 messages are not supported.

The IGMPv3 membership reports proxied by the L2S to the CP interface will have an IP header source of 0.0.0.0. Some legacy sites may use 172.17.17.17.

3.2 User Network Interface (UNI)

3.2.1 General

When a CP orders Multicast for GEA on an L2S, Openreach will enable that capability to all their GEA Data services served by that L2S. It will not be possible to selectively enable Multicast on a per GEA Data service basis. All subsequent end users will be enabled for the Multicast capability as part of their GEA Data order.

A GEA Data service can only be served with Multicast traffic from the Multicast VLAN owned by their CP.

Openreach supports Multicast on the all data ports on GEA-FTTP accesses where a multi-port ONT is used. Each UNI port will only support a single multicast service.

End Users of CPs that have a Multicast VLAN on their L2S will no longer be transparent to untagged IGMP over IP over GEA Data; these packets will be intercepted by Openreach to support the Multicast for GEA service. Transparency may be maintained only if an IGMP frame tagged with a VLAN with a value of 1 or higher is presented at the ONT UNI port.

Openreach will prevent users injecting traffic into the Multicast VLAN; therefore no user-to-user communication is possible through multicast group membership.

Further details on how Openreach processes IGMPs are provided in Table 1 below.

3.2.2 IGMP Operation - User Side

As stated in the IGMP specification [2], there will be no acknowledgement that Openreach or the CP has accepted a membership join report or that a media stream exists for the group and is being sent.

Openreach will employ "fast leave" mode of IGMP. The benefit is most apparent when an FTTC served user changes from one channel stream to another. By immediately cutting the stream of the unwanted channel, the downstream bandwidth is released for the new channel and other services sharing the downstream bandwidth.

Openreach will operate in IGMP snooping mode with proxy agent. The CPE should therefore expect and should respond to IGMPv2 and IGMPv3 specific and general query messages from the proxy agent having a source IP address of 0.0.0.0. Note: Some legacy sites may use a source IP address of 172.17.17.17.

It is recommended that CPs are familiar with Residential gateway requirements to support Multicast as set out in the broadband forum's guidance in TR101 and TR156, available at www.broadband-forum.org/.

3.2.2.1 IGMP encapsulation

IGMP messages intended for the Openreach Multicast service must be sent as IGMP over IP.

IGMP messages sent as IGMPoPPPoE or tagged with a VLAN with a value of 1 or above will be passed to the CP via the GEA Data connection and will not be acted on by Openreach.

In the case of GEA-FTTP, GEA-G.fast and GEA-FTTC circuits with a white Openreach modem/ONT IGMP messages can be tagged with VLAN ID 0 (zero) by the CPE in order to set a preferred 802.1p value upstream. A VLAN tag with an ID of 0 will be removed by the ONT and Openreach provided modems but the 802.1p value will be used to ensure the desired upstream scheulding of the IGMP messages on to the PON and VDSL/G.fast line respectively.

This is summarised in Table 1 below:

Scenario	Action on Openreach modem/ONT	Action on DSLAM/OLT
IGMPoE	Forward to multicast VLAN	Capture IGMP for processing
IGMPoE with VLAN 0	Forward to multicast VLAN and copy priority from VLAN 0	Capture IGMP for processing
IGMPoE with VLAN ≠ 0	Forward to data VLAN	Forward on GEA Data connection as IGMP has two VLAN tags[i]
IGMPoPPPoE	Forward to data VLAN	Forward on GEA Data connection as IGMP is encapsulated in PPPoE[i]

Table 1: Upstream IGMP processing on Openreach equipment

Further information on upstream VLAN tagging can be found in SIN498 [6],SIN506 [7] and G.fast [10] for FTTC (including wires only), FTTP and G.fast respectively.

3.2.2.2 IGMP upstream prioritisation

To ensure IGMP upstream packets are treated with the highest available scheduling priority, the CPE should set the IEEE 802.1p priority field to 3 or above. For GEA-FTTP and GEA-FTTC/G.fast with an Openreach provided modem this is done using VLAN 0 as described above. For wires only GEA-FTTC/G.fast it is the responsibility of the CPE to schedule IGMPs appropriately directly on to the VDSL/G.fast line.

Further information on upstream priority can be found in SIN498 [6],SIN506 [7] and G.fast [10] for FTTC (including wires only), FTTP and G.fast respectively.

3.2.2.3 IGMP use limitations

Openreach will limit the total number of groups a UNI is permitted to join simultaneously to sixteen irrespective of their bandwidth. When the maximum number of joins is reached any subsequent IGMP join requests are dropped.

The maximum rate of IGMP messages that Openreach will process is 10 IGMP packets per second.

3.3 Multicast Operation - General

Openreach will support IPv4 multicast only.

Except for the following restrictions stated, Openreach will accept membership join reports to all groups; there is no support within Openreach network to accept or deny joins based on bandwidth allocation or group addresses permitted to a user or their CP.

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[i] Encapsulated IGMPs forwarded over the GEA Data VLAN are still subject to the rate limitation detailed in Section 3.2.2.3

Openreach will use a common multicast GEM for distribution of downstream multicast content over GPON. All ONTs attached to the PON receive this content but the Openreach ONT will only forward this content to UNIs that configured with the correct multicast VLAN ID and have a valid membership join.

Openreach will support IP multicast group addresses in the range 225.0.0.0 to 239.255.255.255. The range 224.0.0.0/24 reserved range will not be accepted in accordance with IANA rules.

Irrespective of source specific multicast service model implied by the use of IGMPv3, Openreach will not enforce the use of SSM destination addresses (232.0.0.0/8) as defined by RFC3376 (IGMPv3). Likewise there is no special treatment or restriction of the GLOP address range defined by RFC2770.

GEA will replicate multicast streams according to destination MAC address. Since the multicast MAC address is derived from the IP group address, CPs must ensure IP group addresses are unique when a 23 bit mask is applied.

CPs must declare their IP group address ranges used for the multicast service to Openreach and provide Openreach with three to six months' notice of any changes or expansions to the Openreach FTTP/FTTC product team. The ranges will not be enforced although Openreach reserve the right to do so in future if required.

Because IGMPv3 includes backward compatibility to IGMPv2, any host sending an IGMPv2 report will cause the Openreach interface to revert to v2 mode and will initiate an immediate IGMPv2 query to other hosts attached to that interface, thus causing those hosts to revert to IGMPv2 mode. The scope of the Openreach interface for FTTC and G.fast is the modem UNI and attached LAN. For FTTP the interface scope is all ONT UNIs (and their attached LANs) common to that CP on the same PON.

3.3.1 Recommendations for Residential Gateway implementation

Most networked home devices will generate IGMP in relation to uPNP (SSDP) potentially causing unnecessary MAC learning and IGMP processing load on the DSLAM line port. IGMP proxy as described in RFC4605 provides effective layer 2 and layer 3 isolation between the home environment and the Openreach NGA platform. The benefits of IGMP proxy include:

- Source MAC addresses from numerous LAN hosts are not visible to the Openreach network thus eliminating risk of the limited MAC learning table becoming exhausted.
- Reduction in IGMP report flows to the upstream device (Openreach DSLAM or OLT). If the number of IGMP devices in the home is excessive, a high volume of IGMP from uPNP (SSDP protocol) and other non-TV multicast operating system services could impact user experience in terms of reliability when changing TV channels. Group address filtering of non-TV IGMP reports within the residential gateway is also recommended for the same reason.

- Multicast for GEA generates and receives IGMP. This layer 3 protocol conveys parameters such as source IP address and timer values all of which are a potential source of interworking issue. The risk of interworking issues can be reduced, or the level of end to end testing complexity can be reduced if IGMP proxy is implemented. With the isolation provided by proxy working, variants of STB need only be tested against variants of residential gateway and variants of residential gateway against variants of DSLAM. With IGMP bridging/snooping, of all permutations of DSLAM, residential gateway and STB variants would be necessary to ensure service reliability.
- In accordance with broadband forum TR101, a VDSL/G.fast port that is Multicast for GEA enabled will not relinquish elected IGMP querier status. If other multicast routing devices are present in the home or CP data network, this could be problematic without careful consideration at the design stage. IGMP proxy offers an ideal solution.

3.3.2 Known limitations

RFC3376 for IGMPv3 details support for source filtering, that is, the ability for a system to report interest in receiving packets 'only' from specific source addresses, as required to support Source-Specific Multicast [SSM], or from 'all but' specific source addresses, sent to a particular multicast address. Openreach will not support the "'all but' specific source addresses" requirement. Specifically, if GEA receives IGMPv3 report of To_EXclude ({X},G), or Is_EXclude ({X},G), meaning join to group G except from source X (or multiple sources listed), the membership report will be silently ignored by Openreach. If an empty list is provided, the report will be accepted and acted upon.

MAC learning of end user IGMP over Ethernet is enabled for Multicast for GEA. The CP Hand-over Port is restricted to a Maximum 8 MAC addresses. Once this MAC limit has been reached, learning of additional MAC addresses is disabled and frames from unknown sources are dropped on entry to the Openreach head end. The aging time for MAC addresses in the table is 300 seconds; once a source is no longer transmitting traffic its MAC address is removed from the table after this period. Typically, CP's will forward multicast traffic to the NGA head end via one or two edge routers. If this is the case, the restriction of 8 MAC addresses will not be an issue. The MAC address restriction applies to only certain Openreach head ends depending on the vendor of the equipment.

MAC learning of end user IGMP over Ethernet is enabled for Multicast for GEA. This only applies if their associated CP is Multicast for GEA enabled. VDSL and G.fast ports are restricted to a maximum 8 MAC addresses. Once the MAC limit has been reached, learning of additional MAC addresses is disabled and frames from unknown sources are dropped. The aging time for MAC addresses is 300 seconds. Typically, all traffic originating from the end user will be via a layer 3 gateway device in the end user premises. Source MAC addresses from various home computers and networked devices could propagate through the residential gateway depending on the type of IGMP implementation. It is highly recommended that RG's supporting Multicast for GEA implement IGMP proxy as described in RFC4605 [8] as opposed to forms of IGMP bridging/snooping similar to that described in RFC4541 [9]. See section 3.3.1 for a description of the benefits and impacts of not using IGMP proxy. The MAC address restriction applies to only certain Openreach DSLAMs depending on the vendor of the equipment.

4. References

[1] Reserved multicast addresses http://www.iana.org/assignments/multicast-addresses

[2] RFC3376 (IGMPv3) http://www.rfc-editor.org/rfc/rfc3376.txt

[3] RFC2770 (GLOP Addressing) http://www.rfc-editor.org/rfc/rfc2770.txt

[4] Openreach NGA FTTC and FTTP interface specification http://www.btplc.com/sinet/

[5] IEEE 802.1Q http://www.ieee802.org/

[6] SIN498 Fibre to the Cabinet (FTTC) Generic Ethernet Access Service and Interface Description https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

[7] SIN506 Fibre to the Premises (FTTP) Generic Ethernet Access, Service and Interface Description https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

[8] RFC4605 (IGMP/MLD Proxying) https://tools.ietf.org/html/rfc4605

[9] RFC4541 (IGMP/MLD Snooping) https://tools.ietf.org/html/rfc4541

[10] SIN527 Generic Ethernet Access G.fast (GEA-G.fast) Service and Interface Description https://www.openreach.co.uk/orpg/home/helpandsupport/sins/sins.do

5. Abbreviations

CP	Communications Provider
CPE	Customer Premises Equipment
CVLAN	Customer VLAN
FTTC	Fibre to the Cabinet

FTTP	Fibre To The Premise
GEA	Generic Ethernet Access
GEM	Generic Event Manager
GPON	Gigabit Capable Passive Optic Network
ID	Identifier
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
L2S	Layer 2 Switch
NGA	Next Generation Access
NTE	Network Termination Equipment
OAM	Operations, Administration, Maintenance
OLT	Optical Line Termination
ONT	Optical Network Termination device
PON	Passive Optic Network
PPPoE	Point to Point Protocol over Ethernet
SIN	Suppliers' Information Note (BT Publication)
SSM	Source-Specific Multicast
VLAN	Virtual Local Area Network
SVLAN	Service VLAN
UNI	User Network Interface

6. History

Issue	Date	Changes
Issue 0.1	18/06/2010	Initial text provided.
Issue 1.0	September 2012	Initial text reviewed and amended to reflect product status.
Issue 1.1	January 2013	Updated as a result of the maximum bandwidth for Multicast up from 300Mbps to 500Mbps (as a result of additional capability) with additional information on Max MAC settings and additional Residential Gateway settings advice.
Issue 1.2	November 2013	Update to section 3.2.2.1 around IGMP encapsulation behaviour.

Issue 1.3	January 2015	Update to section 3.1.2 Multicast VLAN bandwidths Change SINet site references from http://www.sinet.bt.com to http://www.btplc.com/sinet/
Issue 1.4	December 2018	Update to section 3.2.2 IGMP Operation - User Side Additional clarification text
Issue 1.5	January 2019	General updates and clarifications as part of annual review
Issue 1.6	April 2020	Change SINet site references from http://www.btplc.com/sinet/ to https://www.openreach.co.uk/orpg/home/helpandsupport/sins/ sins.do
Issue 1.7	May 2021	Inclusion of G.fast. Clarifications around encapsulated IGMPs. Addition of requirement to declare IP group address ranges and alert Openreach to any changes
Issue 1.7	May 2022	Annual Review – no changes made – issue number therefore remains the same
Issue 1.7	June 2023	Annual Review – no changes made – issue number therefore remains the same
Issue 1.7	April 2025	Annual Review – no changes made – issue number therefore remains the same

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